SCIENTIFIC KITE FLYING.

SYSTEMATIC observations of the temperature and humidity of the upper air have been made for many years past, both in America and on the Continent, kites being the means employed mostly in America, and kites and balloons on the Continent.

The plan adopted is to send up a kite of some 60 to 80 square feet of lifting surface, the line used being steel music wire instead of string, additional kites being attached to the line as occasion requires. The end kite, or the line close to it, carries a self-recording instrument, and in this way observations at a height approximating to or even exceeding three miles are sometimes obtained, although it is not often that the air motion in the various strata is such as to render a height of more than 10,000 feet possible. The obstacle to be overcome is the pressure of the wind upon the line, which soon reduces the angular altitude of the kite, and it is on this account, rather than on the greater strength of steel for the same weight, that steel music wire is preferable to string, the resistance of the wire on account of its smaller section being so much less.

FIG. 1.—Rhombus kite, 7 ft. 6 in. by 6 ft. by 3 ft. 6 in.

There are few days on which a small elevation may not be reached by a kite, but days really suitable are not plentiful. It is self-evident that a suitable wind is the first requisite, and to obtain a great height a suitable wind must prevail from the lowest to the highest strata reached. We cannot, of course, alter the wind, but fortunately we are able to move the point to which the kite line is attached, and this practically comes to the same thing as altering the force of the wind. The most convenient means of doing this is to fly the kites from the deck of a steam vessel, and during last summer observations were thus obtained for seven weeks almost daily.

The work was inaugurated by a committee of the Royal Meteorological Society, cooperating with a committee appointed by the British Association.[1] They hired a small steam tug of 55 feet length and 14 feet 6 inches beam. The vessel was stationed at Crinan, which is at the north end of the Crinan Canal, on the west coast of Scotland, and, Sundays excepted, kite ascents were made from her deck every day, no matter what the weather, from July 8 to August 26. The vessel could not steam more than seven knots, and the wind velocity necessary to raise a kite is from nine to twelve knots, so that on occasions when it was a dead calm no kite could be started. It happened, however, that no day was calm throughout, so that some time during the hours of daylight the opportunity of reaching at least 1500 feet elevation was afforded. Had the tug been capable of ten instead of seven knots, I have little doubt but that a height of 5000 feet might have been attained every day.

Using one or two kites only, no difficulty was experienced. The most troublesome point was getting the kite together when the wind was strong. The tug was small, and had no bulwarks, so that there was no shelter of any kind on deck, but her smallness was certainly an advantage in another way. A larger vessel would have produced eddies in the wind, and probably have rendered it difficult to start the kite direct from the deck. As it was we had no trouble, and it was very seldom that a kite failed to rise steadily from the starting point. In calm weather the vessel was kept steaming against, or nearly against, the wind so as to produce sufficient relative motion to raise and maintain the kites. In rough weather she was taken out against the wind for some ten or twenty miles until a position was attained from which a clear run down the wind was possible, and the kite was then started. A wind of force 5 on the Beaufort scale is the most suitable wind for kite flying. This is known technically as a fresh breeze, and is sufficient to produce a moderate amount of white on the sea surface. One of the kites of the usual size for scientific kite flying will, in such a breeze, exert a pull of about 50 lbs. The wire used will bear a strain of some 300 lbs., and weighs about 16 lbs. to the mile, so that one kite in such circumstances will take nearly two miles of wire, and, if it be a good one, will raise the instruments to about 5000 or 6000 feet. The pull of 50 lbs. is well within the limits of stability of the kites, and is on the whole about the most convenient to work with, if one can be certain of the goodness of the kite. At Crinan the tug was so manœuvred that a tension of 40 lbs. for each kite on the line might be main-

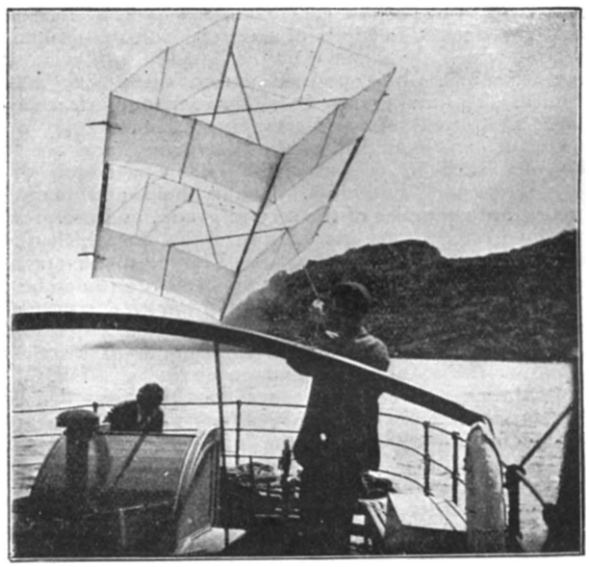

FIG. 2.—Starting a kite from the tug.

[1] See paper on "The Method of Kite-flying from a Steam Vessel, and Meteorological Observations obtained thereby off the West Coast of Scotland" (*Quarterly Journal of the Royal Meteorological Society*, April).

tained, but kite flying is an art of which we were then without previous experience, and so it was well to err on the safe side. A steam vessel is extremely convenient for kite flying, as by altering either her speed or direction the strain upon the wire, provided the vessel is not already going full speed against or with the wind, can be varied with the utmost nicety.

With more than two kites difficulties often occur, owing to the fact that very different wind velocities may prevail at different heights. If the wind is greatest at the surface, adding more kites does not add appreciably to the height of the end one, since no kite can rise into a stratum in which it does not find sufficient wind. This sometimes occurred, but the more usual case was that the wind force increased too rapidly with elevation, so that if the tug were used to increase the relative surface wind to suit the lower kites, it added too much to the strength of the upper wind, and by unduly increasing the force upon the upper kites, put a dangerously high tension upon the wire. If, on the other hand, the tug were moved to suit the upper kites, the lower ones might be becalmed, and useless for lifting purposes, or perhaps even fall into the sea.

Very interesting results have been obtained from these experiments, both in America and on the Continent, but it has been felt that the conditions prevailing over the large oceans are very likely different from those over the continents. The cyclonic disturbances, on the motion of which our weather very largely depends, certainly show a preference for the sea, and it was in the hope that some light might be thrown on their mechanism, and the causes which produce them, that a locality on the west coast of Scotland was chosen for the observations. The evidence obtained from last summer's work is not sufficient to be conclusive, but so far as it goes it tends to show that as a depression approaches, the decrease of temperature with elevation becomes less than it was before. This was the case with every depression that passed while the experiments were in progress, and it leads to the conclusion that the upper air in the neighbourhood of a cyclone is relatively warm, and that the cyclones are convectional effects.

A further result of the observations shows that the temperature of Ben Nevis was in every instance below that of the free air at the same level some sixty miles to the south-west, often from 5° to 8° F. below. That the two air temperatures should have agreed was hardly expected, but the difference was very marked, and it is desirable that the experiments should be repeated in the same locality to confirm the result. The fact, however, that the summit of the mountain is so often wrapped in clouds, when the sky is clear elsewhere, tends to show that the summit must be unduly cold, and it seems likely that the effect is produced by the adiabatic cooling of the air as it is forced up the mountain slope. In fact, the cloud level on all the mountains and hills in the neighbourhood was always much below the point at which the kites entered the clouds. It is also known from the differences in the barometer on the Ben and the values computed from the Fort William readings that the temperature of the intermediate layers of air is not truly represented by the mean derived from the summit and sea-level temperatures.

England being so near the usual cyclonic tracks, observations on the upper air are of especial interest, and it is very desirable that a permanent station for the purpose should be established. It may perhaps be found that unmanned balloons too often fall into the sea to be usefully employed, but the attempt is well worth a trial, and so far as kite observations are concerned, the only difficulty is the financial one.

W. H. DINES.

A NATIONAL DIPLOMA IN AGRICULTURE.

A SO-CALLED national diploma in the science and practice of agriculture can now be obtained by any student who passes the necessary examinations. This diploma has undoubtedly a high-sounding title—it would be difficult indeed to suggest a title of greater weight—and it is therefore not surprising that the number of students entering each year for the examination is steadily increasing, and that successful students should be proud to write the important letters N.D.A. after their names. Now we greatly wish that a truly national diploma in agriculture could be obtained; that a well-ordered scheme of education and examination were authoritatively set forth; and that the skill and knowledge of the nation should be really brought to bear upon the subject. The diploma in question has no right to the title of "national." It is granted by a joint committee of two agricultural societies—the Royal Agricultural Society of England and the Highland and Agricultural Society of Scotland—it should therefore be designated "the agricultural societies' diploma." To claim for it a national importance, and thus to imply that it ranks above all other agricultural diplomas, is simply to mislead the public, and to assert a position to which it has absolutely no right. The question of continuing to grant the diploma in question has lately entered a critical stage; it may be of service, therefore, to set forth in few words the origin and character of the examinations on which it is based.

It must be reckoned as greatly to the credit of the two agricultural societies we have just named that they have been for many years engaged in promoting agricultural education by means of examinations. The Highland and Agricultural Society of Scotland was at the pains to obtain a supplementary charter in 1856 in order that it might add agricultural education to the other functions of the Society. This charter sets forth that "in order to encourage the proper education of agriculturists in Scotland" the Society is empowered to appoint a committee consisting of the professors of agriculture, anatomy, botany, chemistry, natural history, and technology in the University of Edinburgh, with sundry public officials, and seven members chosen by the Society. This committee is to appoint a board of examiners, and to grant diplomas bearing the corporate seal of the Society. The Society has acted on the powers thus given; it has conducted annual examinations in Edinburgh from 1858 to 1899, and granted diplomas according to the terms of its charter.

The Royal Agricultural Society of England possesses no such definite authority as that given to the Highland Society for the conduct of examinations or the granting of diplomas; its charter, given in 1840, merely authorises it "to take measures for the improvement of the education of those who depend upon the cultivation of the soil for their support." The Society has conducted annual examinations in England from 1868 to 1899. Up to 1897 the successful candidates received certificates, but in 1898 and 1899 diplomas were granted.

In 1897 the two societies nominated a joint board of examiners to conduct examinations in the science and practice of dairying, and annual examinations have since been regularly held both in England and Scotland. The successful candidates receive a national diploma in the science and practice of dairying.

In 1899 the two societies took a further step, and appointed a joint board of examiners to conduct examinations in the science and practice of agriculture; the examinations hitherto conducted by the separate societies then ceased. The first examination by the joint board was held in 1900, and such examinations